

Claims:

1. A power and start system for use with an engine, the engine including a shaft, systems requiring AC power, and systems requiring DC power, the power and start system operating in at least a generate mode and a start mode, the power and start system comprising:
- an AC/DC starter/generator mechanically coupled to rotate in response to rotation of the engine shaft in generate mode to produce AC and DC power and to rotate the shaft of the engine when in start mode;
- a generator control unit electrically coupled to the AC/DC starter/generator and the systems requiring DC power; and
- a start inverter configured to be coupled to a DC power source, the start inverter being coupled to the AC/DC starter/generator to provide power for start mode operation.
2. The system in claim 1, further comprising:
- a first controllable contactor coupled to the start inverter;
- a second controllable contactor coupled to the systems requiring AC power;
- and
- a third controllable contactor coupled to the systems requiring DC power.
3. A power and start system for use with an engine, the engine having a shaft, systems requiring AC power, and systems requiring DC power, the power and start system selectively operating in at least a generate mode and a start mode, the power and start system comprising:
- a first AC/DC starter/generator couplable to the shaft of the engine;
- a second AC/DC starter/generator couplable to the shaft of the engine;
- at least one of the AC/DC starter/generators being rotatable in response to rotation of the engine shaft in generate mode to produce AC and DC power;
- at least one of the AC/DC starter/generators rotating the shaft of the engine in start mode;
- a first generator control unit electrically coupled to the first starter/generator and the systems requiring DC power;
- a second generator control unit electrically coupled to the second starter/generator and the systems requiring DC power;
- a DC power source;

a start inverter being selectively couplable to the DC power source; and
a controller coupled to the system for selectively controlling the coupling and
uncoupling of at least the first and second starter/ generators, the start inverter, and the
DC power source.

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4. The system of claim 3, further comprising:

a first controllable contactor coupled to the start inverter and the DC power
source;

a second controllable contactor coupled to the systems requiring AC power
and to at least one of the AC/DC starter/generators; and

a third controllable contactor coupled to the systems requiring DC power and
at least one of the AC/DC starter/generators.

5. The system of claim 4, further comprising:

the second controllable contactor coupled to the systems requiring AC power
and selectively couplable to the first AC/DC starter/generator;

the third controllable contactor coupled to the systems requiring DC power
and the first AC/DC starter/generator;

a fourth controllable contactor coupled to the systems requiring AC power and
to the second AC/DC starter/generator; and

a fifth controllable contactor coupled to the systems requiring DC power and
the second AC/DC starter/generator.

6. The system of claim 5, further comprising:

a sixth controllable contactor coupled to the start inverter and the first AC/DC
starter/generator; and

a seventh controllable contactor coupled to the start inverter and the second
AC/DC starter/generator.

7. A power and start system for use with at least a first engine and a second
engine; the first engine having a first shaft, a first system requiring AC power, and a
first system requiring DC power; the second engine having a second shaft, a second

system requiring AC power, and a second system requiring DC power; the power and start system selectively operating in at least a generate mode and a start mode, the power and start system comprising:

- 5 a first AC/DC starter/generator couplable to the first shaft;
 - a second AC/DC starter/generator couplable to the first shaft;
 - a third AC/DC starter/generator couplable to the second shaft;
 - a fourth AC/DC starter/generator couplable to the second shaft;
 - at least one of the AC/DC starter/generators being rotatable in response to rotation of the engine shaft in generate mode to produce AC and DC power;
 - 10 at least one of the AC/DC starter/generators rotating the shaft of the engine in start mode;
 - a first generator control unit electrically coupled to the first starter/generator and the first systems requiring DC power;
 - a second generator control unit electrically coupled to the second
 - 15 starter/generator and the first systems requiring DC power;
 - a third generator control unit electrically coupled to the third starter/generator and the second systems requiring DC power;
 - a fourth generator control unit electrically coupled to the fourth
 - starter/generator and the second systems requiring DC power;
 - 20 a first DC power source selectively couplable to the first and second AC/DC starter/generator and the first systems requiring DC power;
 - a second DC power source selectively couplable to the third and fourth AC/DC starter/generator and the second systems requiring DC power;
 - a first start inverter being selectively couplable to the first DC power source;
 - 25 a second start inverter being selectively couplable to the second DC power source; and
 - a controller coupled to the system for selectively controlling the coupling and uncoupling of at least the first, second, third and fourth starter/ generators, the first and second start inverters, and the first and second DC power sources.
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8. The system of claim 7, further comprising:
- a DC power source contactor selectively couplable to the first and second DC power sources.

9. The system of claim 7, further comprising:

an AC system contactor selectively couplable to the first and second systems requiring AC power.

5 10. The system of claim 7, further comprising:

an inverter contactor selectively couplable to the first inverter and the second inverter.

11. The system of claim 7, further comprising:

10 a DC power source contactor selectively couplable to the first and second DC power sources;

an AC system contactor selectively couplable to the first and second systems requiring AC power; and

15 an inverter contactor selectively couplable to the first inverter and the second inverter.

12. The system of claim 7, further comprising:

a first controllable contactor coupled to the first start inverter and the first DC power source;

20 a second controllable contactor coupled to the first systems requiring AC power and to at least one of the first and second AC/DC starter/generators; and

a third controllable contactor coupled to the first systems requiring DC power and at least one of the first and second AC/DC starter/generators.

25 13. The system of claim 12, further comprising:

the second controllable contactor coupled to the first systems requiring AC loads and selectively couplable to the first AC/DC starter/generator;

the third controllable contactor coupled to the first systems requiring DC loads and the first AC/DC starter/generator;

30 a fourth controllable contactor coupled to the first systems requiring AC power and to the second AC/DC starter/generator; and

a fifth controllable contactor coupled to the first systems requiring DC power and the second AC/DC starter/generator.

14. The system of claim 13, further comprising:

5 a sixth controllable contactor coupled to the first start inverter and the first AC/DC starter/generator; and

a seventh controllable contactor coupled to the first start inverter and the second AC/DC starter/generator.

10 15. The system of claim 7, further comprising:

an eighth controllable contactor coupled to the second start inverter and the second DC power source;

a ninth controllable contactor coupled to the second systems requiring AC loads and to at least one of the third and fourth AC/DC starter/generators; and

15 a tenth controllable contactor coupled to the second systems requiring DC loads and at least one of the third and fourth AC/DC starter/generators.

16. The system of claim 15, further comprising:

20 the ninth controllable contactor coupled to the second systems requiring AC loads and selectively couplable to the third AC/DC starter/generator;

the tenth controllable contactor coupled to the second systems requiring DC loads and the third AC/DC starter/generator;

a eleventh controllable contactor coupled to the second systems requiring AC loads and to the fourth AC/DC starter/generator; and

25 a twelvth controllable contactor coupled to the second systems requiring DC loads and the fourth AC/DC starter/generator.

17. The system of claim 16, further comprising:

30 a thirteenth controllable contactor coupled to the second start inverter and the third AC/DC starter/generator; and

a fourteenth controllable contactor coupled to the second start inverter and the fourth AC/DC starter/generator.

18. The system of claim 7, further comprising:
a first controllable contactor coupled to the first start inverter and the first DC power source;
- 5 the second controllable contactor coupled to the first systems requiring AC loads and selectively couplable to the first AC/DC starter/generator;
- the third controllable contactor coupled to the first systems requiring DC loads and the first AC/DC starter/generator;
- a fourth controllable contactor coupled to the first systems requiring AC loads and to the second AC/DC starter/generator;
- 10 a fifth controllable contactor coupled to the first systems requiring DC loads and the second AC/DC starter/generator;
- a sixth controllable contactor coupled to the first start inverter and the first AC/DC starter/generator;
- 15 a seventh controllable contactor coupled to the first start inverter and the second AC/DC starter/generator;
- an eighth controllable contactor coupled to the second start inverter and the second DC power source;
- the ninth controllable contactor coupled to the second systems requiring AC loads and selectively couplable to the third AC/DC starter/generator;
- 20 the tenth controllable contactor coupled to the second systems requiring DC loads and the third AC/DC starter/generator;
- a eleventh controllable contactor coupled to the second systems requiring AC loads and to the fourth AC/DC starter/generator;
- 25 a twelvth controllable contactor coupled to the second systems requiring DC loads and the fourth AC/DC starter/generator;
- a thirteenth controllable contactor coupled to the second start inverter and the third AC/DC starter/generator; and
- a fourteenth controllable contactor coupled to the second start inverter and the fourth AC/DC starter/generator.
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19. The system of claim 7, further comprising:

a DC power source contactor selectively couplable to the first and second DC power sources.

20. The system of claim 18, further comprising:

5 an AC system contactor selectively couplable to the first and second systems requiring AC power.

21. The system of claim 18, further comprising:

10 an inverter contactor selectively couplable to the first inverter and the second inverter.

22. The system of claim 18, further comprising:

a DC power source contactor selectively couplable to the first and second DC power sources;
15 an AC system contactor selectively couplable to the first and second systems requiring AC power; and
an inverter contactor selectively couplable to the first inverter and the second inverter.

20 23. A method of providing power to an engine having a shaft, systems requiring AC power, and systems requiring DC power, comprising:

providing an AC/DC starter/generator mechanically coupled to the engine shaft;

25 providing a generator control unit electrically coupled to the AC/DC starter/generator and the systems requiring DC power;

providing a start inverter coupled to a DC power source, the start inverter being coupled to the AC/DC starter/generator to provide power for start mode operation;

30 rotating the AC/DC starter/ generator in response to rotation of the engine shaft to generate AC and DC power;

activating the AC/DC starter/ generator to rotate the shaft of the engine to start the engine.